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ABSTRACT

Although skill in mathematics will be a crucial human resource in the future, there is a national disaffection with and fear of mathematics. To reverse this situation, all teachers should be required to have inservice instruction in mathematics, focusing on how mathematics supports and relates to specific content areas. Teachers' avoidance of and anxiety about mathematics influences the attitudes of students. Two inservice models have been used to develop teachers' mathematical abilities and to help them integrate mathematical concepts into their courses. The model for elementary school teachers includes learning modules on: mathematics anxiety, mathematics concepts, metrics, how children learn mathematics, using manipulatives, games for learning mathematics, motivation for mathematics, learning tools and equipment, problem solving techniques, increasing capacity for mental computation, using mathematics as a tool, and teaching mathematics in other content areas and learning centers. The program for secondary teachers is in three phases. In Phase I, mathematics teachers identify mathematics skills most appropriate for support of other subject areas. They increase their abilities to provide instruction in at least one other subject area through the use of mathematics and develop skills in consultation, curriculum building, and team teaching. In Phase II, one mathematics teacher works with one or more content area teachers in peer support learning teams. The mathematics teacher serves as team consultant in mathematics content, and the content area teachers provide instruction to the mathematics teacher on content to which mathematics can be applied, leading to the goal of team teaching. Examples are appended of elementary and secondary training ideas. (JD)

MATHEMATICS IN CONTENT AREAS

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A TEACHER TRAINING APPROACH

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- ART
- MUSIC
- HOME ECONOMICS
- INDUSTRIAL ARTS
-

SP019796

TEACHER CORPS - WASHINGTON, D.C./HOWARD UNIVERSITY

ALL TEACHERS ARE TEACHERS OF MATHEMATICS . . .

MATHEMATICS IN CONTENT AREAS

MICA

A TEACHER TRAINING APPROACH

BESSIE C. HOWARD

WASHINGTON, D. C. HOWARD UNIVERSITY TEACHER CORPS

PRESENTATION FOR:
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PROGRAM '78

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PREFACE

Concern about student low achievement in and disaffection with Mathematics is a priority of educators, parents, and the professional community that needs skills and competence in mathematics. In response to this concern, the Washington, D. C. Howard University Teacher Corps project focused on a "Mathematics In Content Areas" (MICA) program to address what are preceived to be some major variables contributing to the problem. They are:

(1) That all educational personnel, not just mathematics teachers, have a responsibility and opportunities to support mathematics education, and this has not been acted upon.

(2) Fear, anxiety, and avoidance of mathematics by teachers.

(3) Mathematics taught in isolation of other content areas and careers.

(4) Students perception of mathematics as irrelevant to their daily lives and to success as well as an elitist subject to be mastered by a "strange" few.

(5) An inadequate supply of certified mathematics teachers.

Based on this Teacher Corps experience in four inner city schools, Pre K - 12, the following insights and recommendations are being made.

Hopefully this will be of assistance to the schools, the universities, and the professional community in addressing mathematics in-service education.

Bessie C. Howard
Director

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MATHEMATICS IN CONTENT AREAS (MICA):
A TEACHER TRAINING APPROACH

INTRODUCTION

Mathematics, unfortunately, is one of the most unpopular subjects taught in the schools. How often have you heard a student ask "Why do I have to take this mathematics?" and then say something like "I really hate Math!"? Unfortunately, these attitudes are reinforced by adults, parents and even some teachers. Excuses are made for the student when these adults say "That's right. I never could do math either." or "You came by it honestly, neither your mother or I could ever get Math." or even worse, "That's alright. Girls don't need to know math to get along." This is a serious indictment against the schools in general and mathematics teaching in particular. As our political, social, economic and technological world changes with accelerating speed, and as we become more and more aware of the knowledge interrelationships within these areas, student achievement in Mathematics becomes more and more a survival issue. One of the more basic questions we must answer for ourselves, because it is crucial to how we approach the teaching of Mathematics, is "why should Mathematics be taught?" It may be clear to a given teacher, or supervisor, but not clear to many other

teachers and supervisors, not to mention a concerned parent, or hostile, confused student. The answers will effect: the motivation of students, decisions effecting the priority of Mathematics in the school system, as well as teacher decisions and behavior in the classroom.

EXAMINING THE PROBLEM

There is a national as well as local problem in education---the Mathematics achievement of students and the disaffection with, and even fear of, Mathematics that exists in so many people. These feelings and attitudes are transmitted very early to our youngsters. Data to support this can be found in declining aptitudes after the early primary years and in the research literature on Math Anxiety.

Research has shown us that anxiety, fear, avoidance, and dislike of mathematics has reached epidemic proportions in some of our student populations, notably women and minorities. Yet, every child and adult encounters (and uses) some form of mathematics every day (e.g., using money, managing time, and participating in sports). Reading a newspaper or listening to a newscast requires a mathematical competence for interpreting and analyzing information in order to make intelligent decisions as a citizen, consumer, and voter.

Contributors to the problem are the shortage of persons certified to teach mathematics at the secondary level and those teachers feeling inadequate at the elementary level. Many persons with advanced mathematics backgrounds perceive other career options besides teaching to give more benefits and satisfactions. They, therefore, do not enter the teaching profession. Even those persons with strong mathematics backgrounds, who choose teaching, often have significant deficiencies in their teaching methodologies. Also, having had an intense formal education in mathematics, these persons may not have had adequate experiences with other content areas which are dependent on an integration with mathematics in many ways. As a result, mathematics too often is taught as an isolated exercise in the schools, consisting of rote memorization and recitation of figures. It is presented with little excitement or relevance to the real world of the student. There is also the fostering of the mystique that learning mathematics requires a special kind of "mathematical brain".

Thus, the resulting dilemma of misconceptions, negative attitudes, and inadequate mathematics education is a self-perpetuating cycle of mathematics students who are ill-prepared and even unable to consider an increasingly large number of mathematics-related career options.

On a larger scale we face a future, as a nation, with inadequate human resources to contribute to our social, political, economic, scientific, and technological growth. All these areas are dependent on mathematics at the highest and most creative conceptual levels. It is in these areas we have our greatest future need.

SEEKING A SOLUTION

Students must feel that education, and mathematics in particular, is enjoyable, valuable and achieveable. It is important then, from this perspective, to provide learning experiences or instructional activities in the curriculum which make these values apparent. These experiences must provide students with the math literacy that will enable them to both contribute and receive the fullest benefits from society now and in the future.

One way to accomplish this is through intentional efforts to remove the isolation and elitism from mathematics, and communicate its usefulness, its challenge, and its enjoyment, no matter what the student's main areas of interest may be. In this post-industrial society, into which we are accelerating, mathematics is an integral part of technology and the vast new areas of knowledge still emerging. If the student is to be prepared for the future, not just mathematics teachers, but <u>all</u> teachers have a responsibility to validate the linkage and interdependence between mathematics and other content areas.

It is, therefore, proposed that teachers be prepared to teach mathematics in other content areas. All subject areas, whether art, music, science, social studies, health, home economics, industrial arts, or (even) english, require understanding or skill in mathematics concepts. What is "basic" in mathematics is situational for the future, since we at best can only guess what the future will be. Some basic number facts will be essential to know, but computing itself can be done by machines. Human beings must be able to determine the feasibility of computations; be able to operate those machines which make the computations; and understand how these machines work. But what is more important is for us to be able to use creative, logical, thinking skills to solve the problems (which we are not able to predict always ahead of time) which arise. We must be able to determine what mathematics is relevant to the situation and a process for applying the mathematics needed.

In order to assure that students learn to do this in all areas, teachers must be able to help the students learn and to model this ability.

It is proposed that ALL teachers be required to have professional development instruction in mathematics with a focus on how it supports and relates to the content area(s) the teacher will be certified to teach.

One of the ways to approach this goal of teaching and learning mathematics in support of learning other content areas and developing the logical, creative skills needed, is through a problem-solving process. Problem solving has been identified as a top-priority skill by educational futurists, the National Council of Teachers of Mathematics, The National Council of Supervisors of Mathematics, and the National Advisory Committee of Mathematical Education. How can we develop and apply a curriculum that uses mathematics and other content areas within a problem-solving process? It is this question that is being addressed here.

ASSUMPTIONS:

Several assumptions support utilizing this *MICA approach to the problem.

(1) Fear and anxiety are real deterrents to learning and teaching.

(2) Learning is enhanced by the learner perceiving some relationships between what is to be learned in different subject areas.

(3) Mathematics can be integrated with any other subject area. As a symbol system, mathematics can be used to extend the ordinary means of communication and understanding.

(4) Teachers transfer their anxieties, fears, excitements, enjoyments and values regarding subject matter and learning to students.

*Mathematics in the Content Area

(5) Teachers teach most what they understand best and enjoy most (content and process).

(6) Teachers of content, other than mathematics, can become more aware of and capable of including mathematics in their curricula through in-service training.

(7) A teacher can become more aware of and able to decrease his/her level of math anxiety, fear, or avoidance.

(8) Integrating mathematics with other subject areas will improve the school climate for students and teachers, manifested by:

8.1 decreased math anxiety, fear, and avoidance among students and teachers.

8.2 increased professional satifactions for teachers.

8.3 increased communications and teamwork within faculty.

8.4 students recognizing more the need for and use of mathematics support to other academics.

8.5 increased student awareness of career options.

(9) Teachers are most apt to change the way they teach to improve instruction if:

9.1 the change is operational and is performance-based;

9.2 it is congruent with the teacher's understanding of role and need; and

9.3 the pay-offs are worth the time and energy it takes.

MICA MODELS:

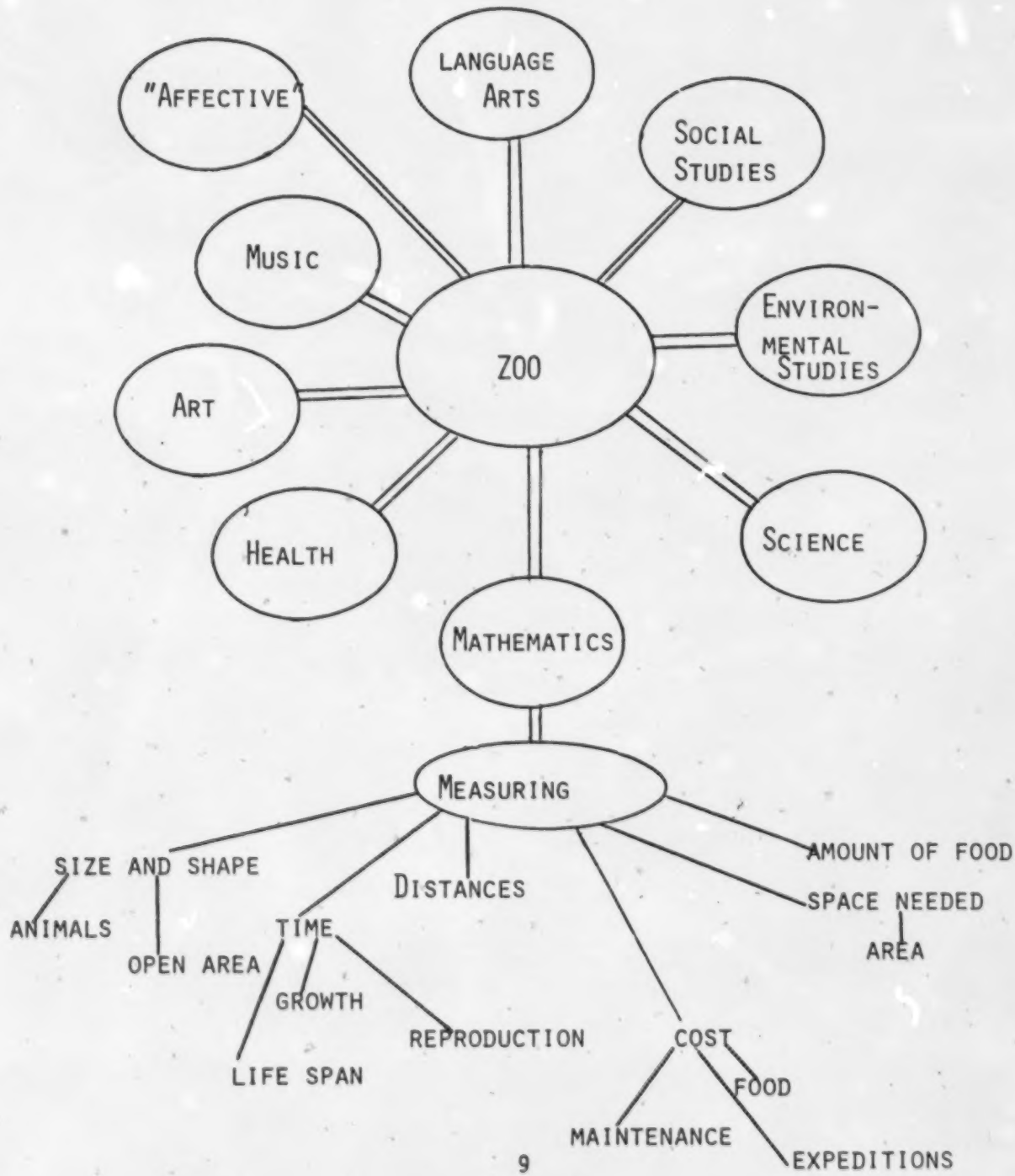
One model for the concept of MICA is a "Thematic Approach". (see figure 1)

The Thematic Approach provides an experience, such as a trip to the "zoo", which becomes the "hub" for a curriculum that focuses on many content areas. Measuring, in mathematics, is related to this experience in a number of ways, as indicated in the figure.

This Thematic Approach is used at the Elementary level as well as the Secondary. The "basic" Elementary MICA model is an integration of mathematics with the total curriculum, content and process (see figure 2) in the Elementary School. The teacher should relate mathematics in a way that supports achievement in other curriculum areas. For example, reading is an important support skill for learning mathematics. Comprehension of word problems is important to beginning a solution. Problem-solving skills support and are supported by mathematics. Young children can begin, very early, being creative about solution strategies for fun and serious problems. Learning centers are used in the classroom to focus on a theme and develop specific math skills related to the theme. Themes should be motivation - inducing for children. Some ideas for these are: Cars, The Zoo, My Neighborhood, The City, My Day, Time, and Our Class. All of these themes can be supported by personal experiences

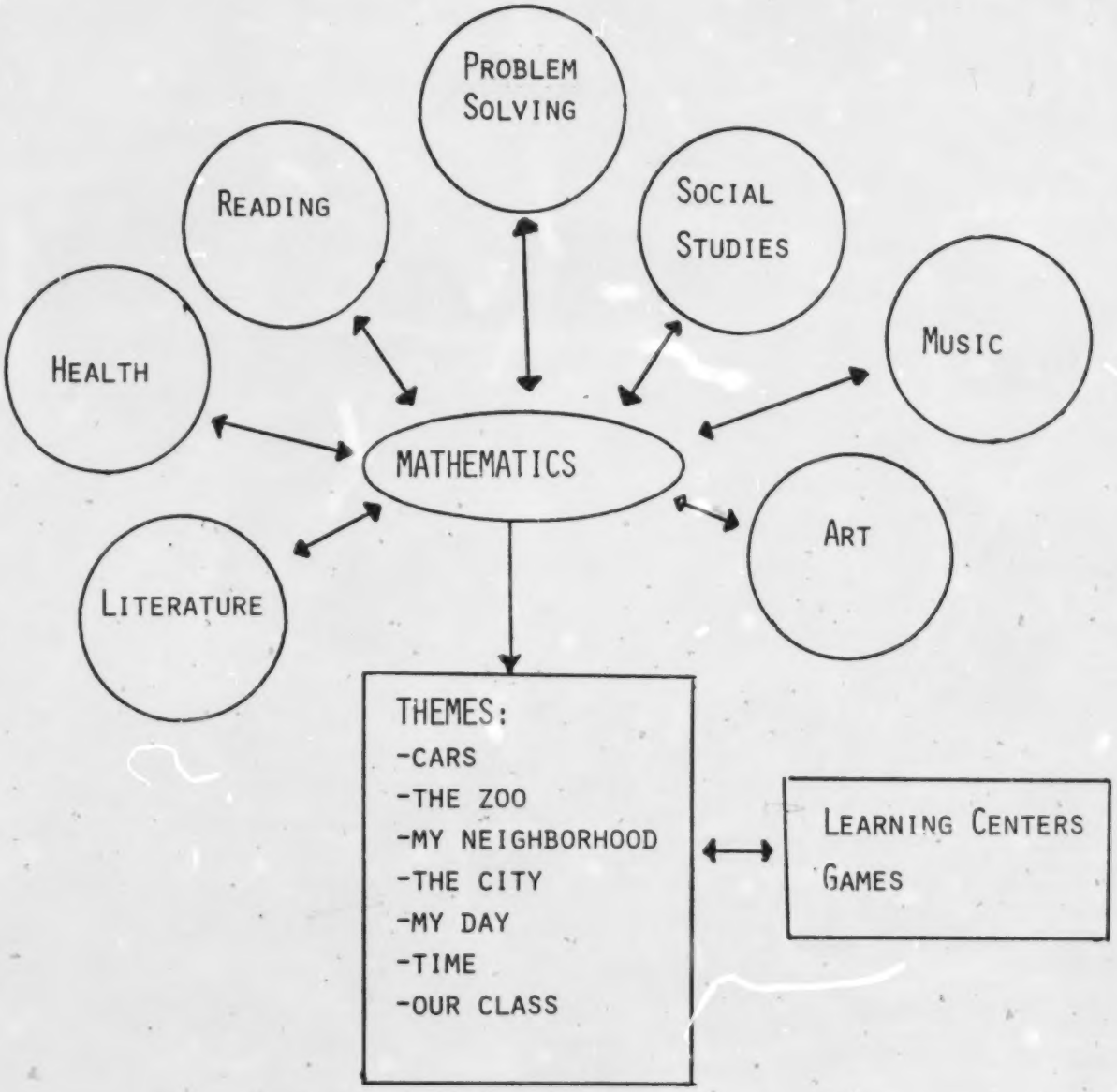
M.I.C.A. A THEMATIC APPROACH

FIGURE 1



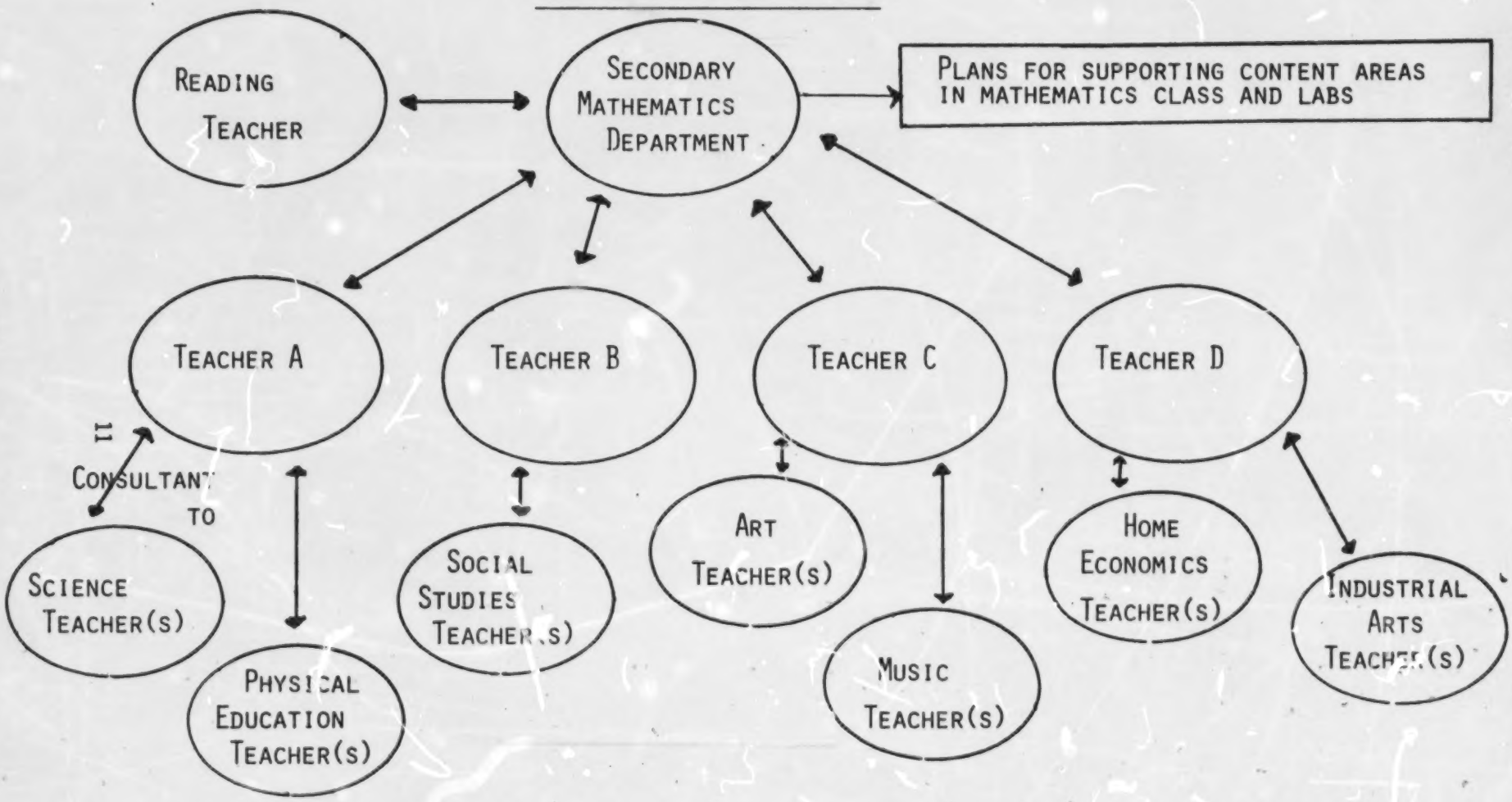
ELEMENTARY M.I.C.A. MODEL

FIGURE 2



AN INTEGRATION OF MATHEMATICS WITH THE TOTAL CURRICULUM CONTENT AND PROCESS

SECONDARY M.I.C.A. MODEL



PLANS FOR SYSTEMATIC FOCUS ON MATHEMATICS IN THE CONTENT AREAS WITH CLEAR ASSESSMENTS OF STUDENT ACHIEVEMENT

PRODUCT DISSEMINATION TO OTHER D.C. PUBLIC SCHOOLS

FIGURE 3

In the Secondary MICA model (see figure 3) a different process takes place; one that recognizes the need for inter-dependence of faculty and subject matter.

As indicated in figure 3, teachers in the Mathematics department make a committment to, and plan for, supporting other content areas in their mathematics classes. This requires the mathematics teacher learning about another subject, either through interviewing peer-teachers, a professional in the community, and/or studying curriculum materials. The Reading teacher is one of the initial peer-support persons for these plans, helping Math teachers develop more skills in assisting students with reading difficulties in Mathematics.

At some point, math teachers (A, B, C, & D in figure 3) contract to dialogue on a sustained basis with one or more teachers in at least one other content area. They interview and consult with each other on ways that learning of the other content area and learning mathematics are mutually supportive. As a result, other subject area teachers develop a higher level of mathematics competency and are able to enhance their subject area through teaching the supportive mathematics. This requires peer-teaching and consultation activities by teachers, and the development of considerable team-work and communication skills.

The following proposals are the result of a two year program in which a small number of inner city teachers worked at improving their own mathematical literacy and at including more mathematics within their curricula in other content areas. The teachers involved increased significantly their own enjoyment of, positive attitudes toward, and competence in the mathematics concepts and skills that were identified as supportive of the subjects they were helping students learn.

At least eight kinds of program components were identified as important to the professional growth of these teachers:

(1) A program design that reflected their input, needs, and wants in terms of delivery modes and content.

(2) Opportunities for interaction and teaming with peers.

(3) Peer-practice sessions to test curriculum ideas.

(4) Use of video-taping for feedback.

(5) An experiential education design of theory-practice-critique-repractice when possible.

(6) Workshops and seminars held during the school day (lunches and planning periods) with after school voluntary follow-up.

(7) Perspectives and support from community professionals who shared how mathematics is utilized in their careers.

(8) Performance-based assessment (self and peer) criteria.

PROPOSAL 1 - ELEMENTARY MICA TEACHER TRAINING

Elementary school teachers make a very significant impact on the future learnings and attitudes of youngsters in the schools. Their values, their interactive styles and their knowledge, are all significant variables impacting student personal and academic growth. How these teachers perceive the value, significance and possible achievement of mathematics has long lasting effects. This program is designed to address the capabilities of elementary school teachers to integrate mathematics into the total curriculum.

This program is designed to help elementary teachers discover more about how children learn; examine rationales for commonly used math methods; experience general strategies, techniques, methods and activities for teaching math topics to underachievers in the elementary school; and how to teach mathematics in other content areas.

Experiential learning and applying math to other subject areas are basic to the design. By doing activities as learners themselves, participants will experience, first-hand, methods for teaching their students. Based on knowledges and skills gained, participants can carry out practical applications of their learnings with children in the classroom. In addition to working together as teams, participants can arrange ways to share their learning with other faculty through formal and informal staff development activities.

The program should be supplemented by video-tapes, filmstrips, field trips and classroom observations which will serve as a basis for the content.

Goal:

As a result of completing the learning modules, participants should be able to demonstrate a variety of instructional methods, strategies, techniques, and activities for helping students enjoy and achieve in mathematics and other content areas.

The program would consist of twelve learning modules:

MODULE I - Math Anxiety

Identify Symptoms, Sources, Causes

Work on relieving own math anxiety

Develop demonstrating strategies for helping students

MODULE II - Math Concepts

Experiencing strategies for concept attaiment

Identifying appropriate concepts and arithmetic operations for problem-solving

Developing concept attainment strategies for teaching math concepts

MODULE III - Metrics

Measuring length, area, volume, capacity, weight, mass and temperature

Discussing difficulties with teaching the metric system and developing strategies

Discussing Metric Measurement with childrn

MODULE IV - Mathematical Development of Children
(How Children Learn Mathematics)

Discussing theories of Learning

Defining the Piagetian Stages of Development

Sensory-motor

Preoperational Period

Concrete Operational Period

Formal Operational Period

Relating math instruction to children's development stages

MODULE V - Using Manipulatives

Using cuisenaire rods, balance scales, geoboards, inch cubes, etc.

Demonstrating the use of manipulatives with children

MODULE VI - Games for Learning Mathematics

Defining the role of academic games

Identifying games appropriate for learning mathematics

Experiencing games in instruction

Developing games for mathematics objectives

Demonstrating with children

MODULE VII - Motivation for Mathematics

Determining motivational factors operant in children

Identifying techniques and strategies to support motivation

Demonstrating techniques and strategies for children

MODULE VIII - Tools and Equipment

Identifying tools and equipment useful for teaching mathematics

Developing personal skills with calculators

Experiencing the drill and practice which computers offer

MODULE IX - Problem Solving Techniques and Strategies

Developing personal problem-solving strategies

Identifying strategies for posing questions, analyzing situations, translating results, illustrating results, drawing diagrams, using trial and error

Identifying factors which contribute to the student's problem-solving abilities

Assisting students in developing problem-solving skills

MODULE X - Increasing Capacity for Mental Computation

Identify techniques, strategies, methods, and techniques for increasing own mental computation capacity

Experiencing teacher strategies for increasing mental computation capacity

Developing strategies for increasing capacity of children to do mental computation

Demonstrating with children

MODULE XI - Using Mathematics as a Tool

Mathematics as a tool for information, communication, estimation, calculation, and application

MODULE XII - Teaching Math in Other Content Areas and Learning Centers

Identifying ways in which math enhances and supports other subjects

Developing approaches to teaching other content areas through use of mathematics

Developing Learning Centers - with special student interest themes

Demonstrating approaches with other content area teachers

Using these approaches in the classroom with children

PROPOSAL 2 - SECONDARY MICA TEACHER TRAINING

PHASE I

Participants: Mathematics teachers and Reading teachers
Meetings bi-weekly - 4 hours (2 groups; 1 self-paced study - 1 classroom follow-up observation/critique by course instructor)

Time frame - 3 months

Goals:

1) During Phase I Mathematics teachers and Reading teachers will develop a cooperative way of supporting a "basic skills" curriculum, supportive of other content areas.

2) Mathematics teachers will learn more about how mathematics support at least one subject area and apply the mathematics they teach to this subject area in their classes.

3) Math teachers will initiate a peer-support model for working with other subject area teachers.

Process:

During Phase I, secondary mathematics teachers will identify the mathematics skills most appropriate for support of other subject areas. They will increase their abilities to provide instruction of at least one other subject area through the use of mathematics, problem-solving, and critical thinking skills. One way to do this can be through dialogue with a peer-teacher with whom the math teacher may work in Phase II. This will establish the interdependence early. They also will develop skills in consultation, curriculum building, and teaming.

Other subject area teachers with whom they would like to team for integrating mathematics into the other subject area will determine their own commitment to being a part of M.I.C.A. in Phase II.

Objectives:

1) Participants will identify mathematics concepts and skills as they relate to other subject/content areas. This will be achieved by talking to another content teacher to address the question of what mathematics is most used for, needed and appropriate to gain competency in that subject; by Math team discussions, focusing on specific mathematics concepts and skills, address the question of how they are useful in other content areas.

2) Participants will improve their own mathematics applications skills through practice.

3) Participants will develop skills in consultation and teaming through participation in workshops.

4) Participants will identify other content teachers they would like to work with in M.I.C.A.

5) Participants will design a consultation model for working with other teachers.

6) Participants will present the M.I.C.A. model to other content teachers and solicit their commitment to be part of M.I.C.A.

7) Participants will show growth through pre and post assessments for all skill development activities.

8) As a result of participant documentation on a common form, program revision will be made to service their needs.

PHASE II

Participants: Mathematics teachers, Reading teachers, identified other content area teachers committed during Phase I.

Time frame - 5 months

Goals:

1) Teachers will be able to work in subject integrated teams to develop increased awarenesses of how mathematics enhances the curriculum of other content areas.

2) Teachers will have increased ability to teach more mathematics to their students as a part of other subject content.

Process:

During Phase II, Mathematics M.I.C.A. teachers will develop contracts with other content area teachers who will be a part of M.I.C.A. The teams (a mathematics teacher and one or more other content area teachers) will develop skills in teaming and in mathematics as it applies to the content area. The team will be a peer-support learning team with the mathematics teacher serving as a consultant to the team in the mathematics content, and the content area teacher(s) providing instruction to the mathematics teacher on content to which the mathematics will be applied.

After developing curricula to support the M.I.C.A. together, the teams will contract for an ongoing relationship with each other and the students relative to teaching content through mathematics, and mathematics through other content. Teams whose schedules permit team teaching and/or provide instruction to the same students have an unique opportunity for instructional impact.

Objectives:

1) As a result of participating in team building activities, mathematics teachers and other content area teachers in M.I.C.A. will have improved communications, sharing, and abilities to work together.

2) As a result of M.I.C.A. teams contracting on their relationships in developing curricula together, they will be able to develop more math-related curricula and skills.

3) M.I.C.A. teams will improve their mathematics and content area competencies.

4) Teams will be able to develop curricula integrating mathematics and the content area.

5) Pre and post assessments of M.I.C.A. for all activities - teachers and students, in mathematics and other content areas, will indicate improvement and growth.

6) As a result of participants documenting all the above activities, the program can be revised to meet needs and wants.

7) As a result of follow-up classroom observations and critiques be to identify the effectivenesses of the curriculum and to give feedback, teachers can continue to improve instruction.

PHASE III

Time frame - unlimited

This phase is a time for implementing curriculum plans, assessing the effectiveness of the curriculum, revising, validating, and expanding the M.I.C.A. concept to include other teachers. It is also a time to identify and solicit needed administrative support so that the M.I.C.A. concept can be continually upgraded and institutionalized.

Summary

There has been a national hue and cry from parents, businesspeople, government workers, and educators over the inability of our young people to "do" mathematics. ("blame the victim") Low test scores, students graduating without basic computational skills, those who enter college unable to meet minimum requirements for entrance into many career preparation programs, - are all the evidences being cited to show that youngsters "cannot" or "will not" learn mathematics. As educators we have tried a number of corrective procedures and vast changes in philosophy (from new math to open education, to competency-based education, to "back to basics") with little success. What has been missing in all these efforts is emphasis on the major facilitators of learning - the teacher - with all the known socialization of students and values transmitted by them to students. Students will have difficulty overcoming the fears and dislikes they learn from their teachers and parents. They will have difficulty integrating concepts from one content area to another if the teacher does not help make these linkages. It is essential that we explore the mathematical deficiencies of our curricula, as transmitted by teachers, if a basic change in the decreasing mathematics achievement of students is to take place. Every teacher must be able and required to teach mathematics in the content area,

thus supporting the notion of mathematics as a basic, functional, survival skill which is attainable by all students.

To prepare teachers to be able to teach in this integrated way, some attention must be given to:

1) sensitizing teachers to the present needs of individuals and the future career options they must prepare students to be able to consider;
2) increasing their awareness of the value of mathematics to achievement in other content areas;
3) decreasing teacher math anxiety, fear or avoidance;
4) increasing the mathematical literacy level of other subject area and elementary teachers;
5) increasing the ability of mathematics teachers to support other content areas in their math classes;
6) providing the opportunity to work with peers in developing the integrated curriculum.

APPENDIX

The following pages are examples of elementary and secondary training ideas that were used to assist teachers in developing MICA curriculum strategies.

MICA

Mathematics in Social Studies

The student will be able to:

* Define latitude and longitude and locate places using the given cooridnates for each place.
* Identify the cardinal directions (north, south, east, west).
* Use the symbols from the map key to measure the distance between two given points.
* Demonstrate ability to use reliable sources of information.
* Use mathematical skills to solve personal economic problems.

A

Car math

An odometer tells how far a car has traveled.

These are the odometer readings for a trip.

Arrive

2	6	3	4	7	2	26347.2 miles

Start

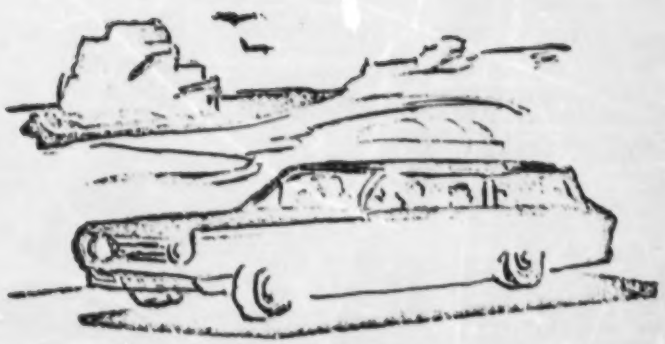
2	6	2	3	8	7	26238.7 miles

1 How far did the car travel?

_____ miles

2 The average speed was 35 miles per hour. How long did the trip take?

_____ hours



From: Activities In Mathematics Second course

MICA

Mathematics in Language Arts

Strands:

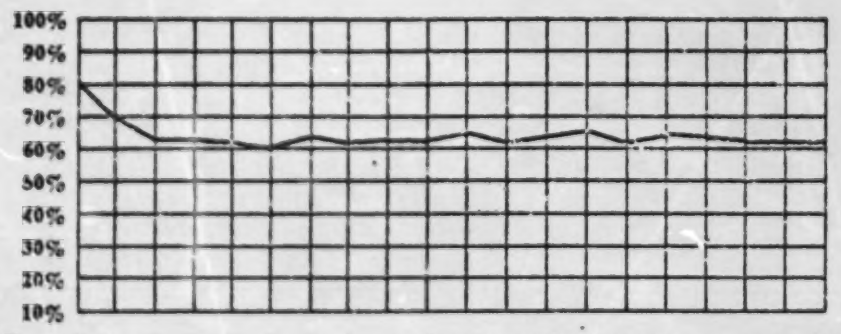
- Listening
- Speaking
- Writing
- Literature
- Nonverbal Communication
- Mass Media
- Study Skills

The student will be able to :

* Identify messages conveyed by signs and symbols.
* Identify information on two types of graphs.
* Construct a graph.
* Distinguish complete sentences from fragments.
* Apply the rules for effective study by completing a specific assignment.

Example: We can't tell how thumbtacks will land when we toss them until we try. We could toss 10 thumbtacks for a total of 20 tosses and record the number landing UP as shown in the accompanying table. We can also compute the per cent that land UP on each toss. We can keep a cumulative score of the number landing UP and then compute the cumulative per cent landing UP. Finally, we can graph that cumulative per cent, as is done in the graph below the table.

Toss No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. Landing Up	8	6	5	6	6	5	8	5	7	6	8	6	7	9	3	8	4	5	4	6
Cumulative No. Up	8	14	19	25	31	36	44	49	56	62	70	76	83	92	95	103	107	112	116	122
Cumulative % Up	80	70	63	63	62	60	63	61	62	62	64	63	64	66	63	64	63	62	61	61



Graph Showing Cumulative % of Tacks Landing Up

From: Mathematics of Life Insurance

Mathematics in Reading

* Given a diagram of basic shapes (circle, triangle, rectangle, square), the student will identify the shapes.

* Using visual memory of the formation of common geometric shapes, the student will construct common geometric forms by defining their perimeters.

* Given root words, and a choice of prefixes, the learner will construct words having prefixes.

* Given a series of words in random order (days of weeks, months of year, etc.,) the learner will order the words.

* Given words and directions related to dictionary/directory information, the learner will demonstrate the correct use of the dictionary/directory to locate the appropriate information.

WHAT IS IMPORTANT?

Every minute of every day you are gathering facts. You are also deciding what to do based on these facts. Sometines you gather in facts even when you are not aware you are doing so. Right now you know where you are, what you are doing, how you are feeling, and many other things. You have made no effort to learn these facts. You know them without any thought, just by seeing and feeling.

You may have to work harder to get other facts. These facts may have been gathered by other people and put in special forms. The facts may be arranged to tell a story. They may be commands or instructions. They may be a timetable or a set of figures. Based on what you need or want to know, you must decide for yourself what facts are important for you to know.

In the following exercises, you will be looking at facts in different forms and picking out the most important facts for you to know at a particular time. Follow the instruction in each question.

(1) *If you want to get to school on the bus, which of the following facts is most important for you to know? Circle the letter of the correct answer.*

a. *The bus is yellow.*
b. *The bus was new last year.*
c. *The bus stops at your corner at 7:30 in the morning.*
d. *The driver's name is Sally.*
e. *The bus carries sixty-two people.*

(2) *You have $1 to spend at the Burger Shop. Which of the facts below would be most important for you to know? Circle the letter of the correct answer.*

a. *Tastyburgers cost $1.*
b. *Tastyburgers have two meat patties.*
c. *French Fries cost fifty-five cents.*
d. *You can eat inside or out.*
e. *You can put on your own relish.*

MICA

Mathematics in Science

* Identify the center, north, south, east, and west directions on a flat surface map.

* Using teacher-made maps of Washington, D.C., distinguish the northeast, southeast, northwest, and southwest sections of the city.

* The student will distinguish the degree of warmth or coolness on an uncalibrated thermometer by associating relative temperature to the level of liquid in the thermometer.

* The student will be able to construct a model and data chart of the planetary system, from which he will communicate specific information to others. (Include distance from the sun, size, periods of revolution and rotation.

* The student will be able to identify at least three instruments used to measure conditions of the weather.

Reading graduated scales can be explained or taught by using illustrations. Thermometers make good examples. In figure 1, the indicator (top of the mercury column) is between 20° and 30°. Thus, to find the value of the mark between 20° and 30°, we need to find the difference between 20° and 30°—that is, 30° − 20°, or 10°. The portion of the graduated scale between points *A* and *B*, that is, between 20° and 30°, has been divided into two spaces of equal length. Thus, each space represents 10° ÷ 2, or 5°. So the indicator is 5° above the lowest marked point of 20°. Thus, the indicator is at 20° + 5°, or at 25°.

In figure 2, the indicator is between the two marked points of 10° and 20°. This interval has been divided into five spaces of equal length. Thus, each space represents

$$(20° - 10°) \div 5 = 2°.$$

The indicator is two spaces above the 10° marking; thus, the thermometer reads

$$10° + (2 \times 2°) = 10° + 4° = 14°.$$

Note that we count the number of *spaces*, not the number of lines, between the marked points. In the last illustration we counted five spaces, not the four lines between 10° and 20°.

Figure 3 shows a rather simple case where the 10° interval (30° − 20°) has been separated into ten spaces of equal size. Thus, each space represents 10° ÷ 10, or 1°. The thermometer is reading 20° + 8° = 28°.

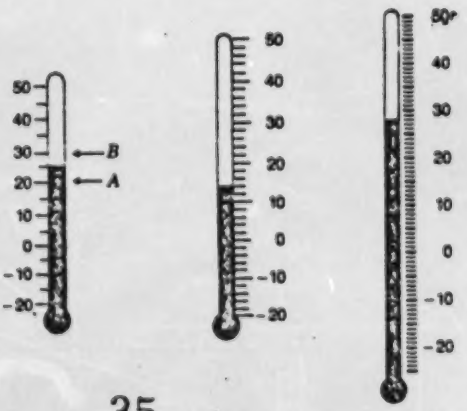


Fig. 1 Fig. 2 Fig. 3

From: Mathematics Teachers

Figures for article drawn by Allan M. Smith, Media Services, Richmond Public Schools.

MICA

Mathematics in Music

Musical Concepts and Skills:

* Performing
* Demonstrating

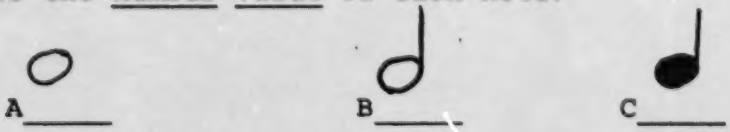
Musical Knowledge

* Listening (with discrimination)
* Reading Writing

* Given a 3-4 note series, the student will arrange notes in several styles (steps, intervals, tone clusters, etc.)
* While observing pictures of objects of varying lengths, the student will name specific objects in the pictures as "LONG" or "SHORT."
* While observing prepared scores of duple and triple meter, the student will describe the function of meter signatures.
* While observing devised scores indicating measured sounds and silences, the student will distinguish among note and rest values and accent frequency.
* Given pentatonic and diatonic scale patterns, the student will describe scale structure in terms of whole and half steps.

MUSIC

1. What is the number value of each note?



A_____ B_____ C_____

2. How many beats will each note get if the whole note gets 4 ?

A_____ B_____ C_____

MICA

Mathematics in Art

Strands:

* Drawing
* Painting
* Cut-Paper Construction
* Sculptures and Modeling
* Printmaking
* Weaving
* Stitchery
* Art Therapy

* Identify basic geometric shapes, such as circles, squares, rectangles, and triangles cut these shapes from paper, and arrange and paste them on a background at random and/or in pictorial form.

* Demonstrate making cubes, rectangular solids, pyramids, cones, and cylinders, including techniques for spiraling, pleating, curling, fringing.

* Make a collage by cutting or tearing shapes of various sizes from a collection of pictures and an assortment of paper, arranging them randomly on a background, using a subject or theme, and pasting in place neatly.

* Make a design by cutting---stencils and rubbing different colored crayons over the stencil onto paper, using---geometric forms as subject matter.

* Make a tempora painting of a selected subject, with emphasis on geometric or free forms.

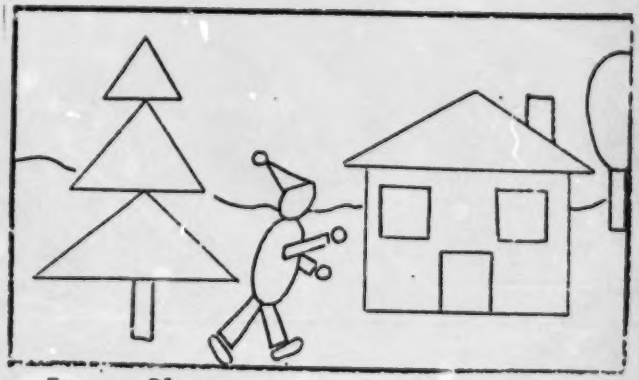
GEOMETRIC ART (GRADES 2-3-4-5-6-7-8)

A. *PREPARATION AND MATERIALS: Have the children help you prepare a box of various geometrics shapes cut from colored construction paper and ask each child to cut the shapes he needs for his picture.*

Each child will need a generous supply of shapes, paste, crayons, and a sheet of manila paper.

B. *INTRODUCTION: Pick up a few of the shapes before you and see if you can arrange them to resemble something. Perhaps you can put together some pieces and make a fish or a bird or a tree. (Call everyone's attention to some of the more creative arrangements.)*

Example:



30 From: Plus

MICA

Mathematics in Physical Education and Health Education

Competencies:

* Basic Movement
* Gymnastics
* Fitness
* Sports
* Sportsmanship
* Safety
* Dance

The student will be able to:

* Form an accurate circle formation with one's classmates, and remain in quiet while the class counts off by specified numbers/ letters or while the teacher is giving instructions.
* Name what each of the six (fitness) tests measure about body fitness, compute and evaluate one's percentile average in regard to sex and age, following participation in the fitness tests.
* State the strategies, rules, positions, skills, supplies, costs required of at least three advanced games/sports and at least how to draw an accurate circle on the blackboard or hardtop.

Health Strands:

* Feelings
* Growth
* Body
* Reproduction
* Foods
* Personal Welfare
* Community Health
* Name and distinguish the foods in the basic four food groups.
* Plan meals for one day that will provide him/her with the necessary daily natrients.

FOOTBALL (GRADES 2-3-4-5-6)

A. PREPARATION AND MATERIALS: Draw 11 parallel lines on the board. By each line write a number suitable for part of an addition problem for your grade level.

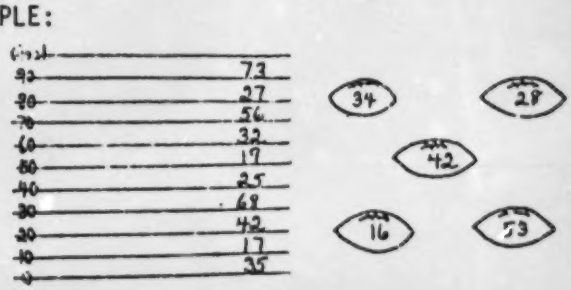
Cut five small footballs of tagboard. On each football write a number also suitable as an addend in a problem at your grade level.

B. INTRODUCTION: In our game of arithmetic football, you must work very quickly and accurately if you want to score a touchdown.

Team A will carry the ball first. Their first player will draw a football from this group on my desk. He will take it to the board. By each ten yard line there is a number. He will mentally add the number of his football to the number on the ten yard line and announce his answer. Then he will add the football number to the number on the twenty yard yard line, the thirty yard line, and so on, working towards the goal line.

If he can complete all additions correctly within 20 seconds (make your standards stiff--remember, making touchdowns on a real field is nat a snap!), he will score a touchdown and make 7 points for his team.

EXAMPLE:



MATHEMATICS IN CONTENT AREAS - SECONDARY

FORMAT BY
MS. GWENDOLYN MEANS

CONTENT AREA	MATH CONCEPT/SKILL	ACTIVITIES
GEOGRAPHY	RATIOS	INTERPRETING DISTANCE FROM SCALE UNITS
	NUMBER LINE	IDENTIFYING LONGITUDE AND LATITUDE LOCATIONS
DRIVERS EDUCATION	MEASUREMENT	DETERMINING DISTANCES DOING ACTUAL MEASUREMENTS
	MAPPING	INTERPRETING SYMBOLS USING THE LEGEND
BIOLOGY	MEASUREMENT	RECORDING: - LINEAR GROWTH IN PLANTS - WEIGHT OF ANIMALS
	GEOMTERIC FIGURES	IDENTIFYING SHAPES IN NATURE: - BEEHIVE (HEXAGON) - BACTERIA (RODS AND SPHERES)

MATHEMATICS IN CONTENT AREAS - SECONDARY

FORMAT DESIGNED BY
MS. GWENDOLYN MEANS

CONTENT AREA	MATH CONCEPT/SKILL	ACTIVITIES
ART	RATIO/MEASUREMENT	REPRODUCING IN MINIATURE OR TO SCALE
	PLANE FIGURES	DRAWING GEOMETRIC FIGURES
		IDENTIFYING GEOMETRIC FIGURES IN ART FORMS
MUSIC	EQUIVALENT FRACTIONS	READING TIME SIGNATURES - NUMBER OF BEATS/ MEASURE - UNIT NOTE - DEMONSTRATING RHYTHM PATTERN - COMPUTING NOTE VALUES
	SEQUENCES	IDENTIFYING REOCCURRING MELODY PATTERNS

MATHEMATICS IN CONTENT AREAS - SECONDARY

FORMAT BY
MS. GWENDOLYN MEANS

CONTENT AREA	MATH CONCEPT/SKILL	ACTIVITIES
ENGLISH AND READING	INTERPRETING SYMBOLS	IDENTIFYING SENTENCES AND PHRASES (E.G., VERB SYMBOLS: $=, <, >, \sim, \leq$
PHYSICAL EDUCATION	NUMBER LINE	DESCRIBING OR CONSTRUCTING A MODEL OF A FOOTBALL FIELD
	RATIOS AND DECIMALS	BATTING AVERAGE, PASS COMPLETION AVERAGE, AND FIELD GOAL AVERAGE
EARTH/ASTRO SCIENCE	INDIRECT MEASUREMENT	DEMONSTRATING MEASUREMENT OF DISTANCE OBJECTS
	ELLIPSES AND PARABOLAS	ORBITS AND TRAJECTORIES

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